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ABSTRACT

In 1991, a study was conducted at San Juan College (SJC) to examine existing research, issues, and faculty attitudes and needs regarding computer-assisted instruction (CAI). A faculty needs assessment survey was prepared and conducted, a review of the research literature was undertaken, and initial guidelines were drafted for the utilization of CAI at SJC. The literature review suggested that the most effective use of CAI is drill and practice for students who have some basic skills. During the spring term, all 175 full- and part-time faculty at SJC were surveyed regarding their attitudes toward CAI and their needs for assistance and support in implementing CAI. Survey findings, based on an 18% response rate, included the following: (1) most faculty believed that CAI is most useful activities outside of the classroom, such as practicing skills, enriching study materials, and testing knowledge: (2) faculty expressed the need for information about CAI packages in their subjects, an evaluation facility, and information about the uses of CAI for work outside the classroom; (3) respondents were also willing to explore in-class uses of CAI provided that it contributes to productivity and teaching effectiveness. The study report includes guidelines for making progress in the instructional and administrative uses of computers. The survey instrument, a draft policy and procedures statement, and a list of selected educational system vendors are appended. (JMC)

IMPLEMENTING CAI AT SAN JUAN COLLEGE: Toward the Campus of the Future

by

John B. Griffiths, Ph.D.

August 15, 1991

A Staff Development Mini-grant Report

Abstract

A report on a research project examining research, issues, and faculty attitudes and needs regarding Computer Assisted Instruction (CAI). Research suggesting that the most effective use of CAI is drill and practice for students who already have some basic skills is reported. Results of a survey showing that faculty have generally positive attitudes toward CAI but need to know more about it are also reported. Initial guidelines for the use of CAI and objectives for institutional policies and procedures are suggested.

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I. Introduction

This report presents the results of research carried out under a San Juan College Staff Development Mini-grant. The subject of the the grant research was Computer-Assisted Instruction (CAI). The grant was awarded because the introduction of computing resources for students and faculty at San Juan Cclllege has created a need for some consistent guidelines for the use of CAI. It is also important that the available software resources - for example, CAI packages for discipline and skill-specific learning, and authoring packages for development of new CAI programs - be identified and organized for faculty access.

In order to improve the way that the college's CAI resources are implemented and managed, an initial faculty needs assessment survey was prepared and conducted; literature and software publisher research to identify resources and methods was conducted, and initial guidelines for utilization of CAI at San Juan College were drafted. In addition, a CAI resource catalog has been started, and some faculty orientation and training materials for CAI have been developed.

II. Computer Assisted Instruction

A. Principles

The idea that a machine can be used to teach is not new, as B.F. Skinner has shown, the possibility that certain equipment might encourage the student to take an active role in the instructional process was recognized in the 1920's by Sidney L. Pressey, who designed several machines for the automatic testing of intelligence and information. Pressey pointed out that such machines could not only test and score, they could teach:

> *When an examination is corrected and returned after a delay of many hours or even days, the student's behavior is not appreciably modified. The immediate report provided by a self-scoring device can have an important instructional effect. Pressey pointed out that a student learned something when told that his answers are right or wrong and that a self-scoring machine could therefore teach. Pressey also pointed out that such machines could improve teacher effectiveness by permitting students to proceed through material at a self-paced rate.*[1]

Here we have the foundations for CAI identified over 50 years before the advent of computers in education: **immediate feedback** of results and **self-paced work.**

Since the introduction, in about 1975, of microcomputers in schools, we have seen a great deal of research and reports describing the methods, efficiency and efficacy of CAI. There is still much debate over these matters, but it has

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[1] B.F. Skinner. The Technology of Teaching. Meredith Corporation; New York: 1968. pp. 30-32.

become more apparent that CAI does have measureable benefits. CAI has become widely accepted and even recommended as an instructional resource. For example, in 1989, a study was conducted to examine basic mathematics programs in the California community colleges and to produce specific program recommendations for the mathematics curriculum at Saddleback College. Results of the study led to several conclusions: "in light of the diversity of the students enrolled in basic mathematics courses, a variety of instructional styles are warranted, including **self-paced instruction, computer-assisted instruction**, and faculty and peer tutoring."[2]

In 1983 the National Council of Teachers of Mathematics proposed a taxonomy for six different categories of CAI:

1. **DRILL AND PRACTICE**. Assumes previous instruction concerning specific concepts, skills, and procedures.
2. **TUTORIAL**. Interactive instructional process in which the direction and level of activities are shaped by student input.
3. **SIMULATION**. Represents key aspects of environments in which students apply learned knowledge in making decisions and in which students are informed about the consequences of their decisions.
4. **GAMING**. Represents environments that include

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[2] S. Sworder. Arithmetic in the California Community Colleges. ERIC/RIE Reports. 1989.

competition, rules, strategic choices under uncertainty and that exercise specific skills in problem contexts.

5. **PROBLEM SOLVING.** Formal methods for achieving correct solutions to defined problems.
6. **INFORMATIONAL.** Sources of data from algorithms or data sets.[3]

Although not all CAI resources fit clearly into these six categories they provide a good outline of fundamental, operational approaches to CAI. We might add, incidentally, that category 6. could include laboratory, measurement and instrumentation interfaces for data acquisition.

B. Trends

N.R. Preston identified the top trends and issues in educational technology for the period from October 1, 1988, through September 30, 1989. These were: (1) a concern for the design and development of instructional products and procedures; (2) an increasingly important role for evaluation in the instructional process; (3) an increasing use of research and development to solve current teaching and learning problems; (4) the presence of computers in almost all public schools in the United States; (5) the wide acceptance of interactive video as a research and development product but not in schools and higher education;

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[3] W.P. Heck, J. Johnson, and R.J. Kansky. Guidelines for Evaluating Computerized Instructional Materials. Reston, VA; National Council of Teachers of Mathematics: 1983. pp. 12-13.

(6) the establishment of distance education as a major vehicle of instruction at all levels of education and training; (7) a preoccupation among practitioners with professional education in the field; and (8) a concern for the impact of technology on society at large.[4] All these trends are related to issues arising from the development, implementation, and management of CAI resources.

The central concern in CAI is pedagogy - the manner and methods by which software can be applied to instruction. Formative research on educational computer software has traditionally focused on comprehensibility, appeal, and usefulness,[5] but as we will see, the results of research in CAI are now providing empirical data about the relative efficiencies of various instructional strategies. There is also progress reported in research in the principles and methods of instructional design.

Obviously, instructional units cannot be considered in isolation, for example, a study conducted in Cuyahoga Community College (Ohio) demonstrates that students' prior skills play an important part. The study was to determine, among other things, whether microcomputer-assisted

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[4] N.R. Preston, Ed. "Trends and Issues in Educational Technology: 1989." ERIC Digest. ERIC Clearinghouse on Information Resources, Syracuse, N.Y. 1990.

[5] M.A. Honey. "The Role of Formative Research in the Design of Educational Computer Software." Technical Report No. 49. Bank Str et Coll. of Education, New York, NY. Center for Children and Technology. 1990.

instruction using tutorial/drill programs would significantly increase students' learning of economics concepts as measured by pre- and post-tests, and to assess the validity of prior achievement in mathematics and reading comprehension for predicting learning. CAI was given to the experimental group, while the control group experienced traditional lecture/discussion instruction. Significant pre-experimental differences between the control and experimental groups prevented substantive comparisons and conclusions about the effectiveness of the microcomputer assisted instruction, but prior achievement in mathematics and reading comprehension proved to be powerful predictors of economic learning.[6] These types of results suggest that an emerging trend in CAI is an increasing amount of attention on the problems of the integration of CAI and other instructional modes, and, indeed, current research reflects this concern.

Another important trend in CAI is the growth in peer-to-peer sharing of information among faculty; newsletters and professional journals publish many "how-to" articles and case studies. For example, the Computers in Life Science Education series consists of over four volumes of background information and practical suggestions on computer use for life science educators who anticipate or are currently using

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[6] A.A. Clegg and others. Using Microcomputers in Teaching Economics in the Community College. ERIC/RIE Reports 1988.

microcomputers as an educational tool, Topic areas include: (1) teaching physiology and other life sciences by microcomputer; (2) enhancing lectures with a microcomputer; (3) simulation of biological systems; (4) projecting microcomputer images; (5) optical videodiscs; (6) computers in the student laboratory; (7) tutorials in anatomy and physiology community college classes; (8) computer-based exam construction in microbiology and immunology; (9) inceractive video; (10) programming languages; (11) input/output design; and (12) computer assisted instruction for health care professionals.[7]

A popular trend in information-sharing is the published evaluation of educational software, for example, since 1984 over 62 evaluations of specific educational computer software offerings have appeared in the journal "The Physics Teacher."[8] Many other subject-specific and general, professional journals now publish software reviews and the Educational Products Research Institute, among others, publishes comprehensive software reviews.

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[7] H. Modell, Ed. Computers in Life Science Education; v1-4 1984-87.

[8] J.S. Risley. "Using Physics Courseware." Physics-Teacher; v27 n3 pp.188-92 Mar 1989.

III. Computer Assisted Instruction at Community Colleges

A. Progress and Practice

Community colleges have been quite active in the adoption of CAI, indeed, the computer represents one of today's best opportunities for innovation in community colleges, as is shown by the fact that the League for Innovation in the Community College's current role is defined in terms of leadership development and **the promotion of innovative uses of computer technology**, especially with regard to innovations in computer applications for assessment and advisement, instruction, and networking.[9] D. Doucette, Associate Director of the League for Innovation in the Community College points out some of the factors that make community colleges particularly appropriate places for the innovative integration of computers into instruction. These factors include the tendency for community colleges to standardize instructional materials across all sections of a course; the remediation requirements of a significant proportion of community college students; and the growing interest of the computer industry in community colleges, which now enroll approximately fifty-five percent of all first-time freshmen each fall.[10]

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[9] G.E. Goodwin, Ed. Celebrating Two Decades of Innovation, 1968-1988. League for Innovation in the Community Coll., Laguna Hills, CA. 1988.

[10] D. Doucette. "The Community College and the Computer: Behind Widespread Integration into Instruction." Academic Computing; v4 n5 p12-14,51,54-56 Feb 1990.

Community college uses of computer resources for instruction are widespread and varied and the literature is, as I have noted, full of examples: IBM and Apple microcomputers are being used in U.S. history survey courses at Johnson County Community College in Kansas;[11] and a 1985 survey of two-year community colleges' use of personal computers in accounting courses illustrates that PCs have been in use in community college accounting courses now for at least 6 years.[12]

Although most instructional computing hardware resources are stand-alone microcomputers, community colleges report increasing use of Local Area Networks (LAN's) for writing instruction, apparently because of the printer-sharing capability of such facilities. For example, the Northern Virginia Community College in Woodbridge, VA, has adapted an instructional computer network originally developed to teach hearing impaired individuals to write; it is now used as an integral part of three different writing courses.[13] The Union County College in Cranford, New Jersey has expanded its capabilities and the amount of service it provides to at-risk students through the Computers in the Curricula Project. Instructors using the project network to teach

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[11] K. Xidis "Students, Micros, and Software: A New Approach in History Courses." History Microcomputer Review; v4 n2 p15-20 Fall 1988.

[12] M. Cerullo and others. "Personal Computer Usage in Community College Accounting Courses." Computers and Education; v13 n3 p265-70 1989.

[13] D.P. Thompson "Teaching Writing On a Local Area Network." Technological Horizons in Education; v15 n2 p92-97 Sep 1987.

writing note that the network has become more of an ordinary part of the curriculum and is now taken for granted.[14]

The role of community colleges in the delivery of distance education is also reported to be supported by computer resources. For example, John Wood Community College (JWCC), which serves a predominantly rural section of west-central Illinois, is addressing the needs of the rural long-distance learner through a variety of instructional delivery techniques. JWCC's Open Learning Centers utilize audio and video taped materials and computer-assisted instruction to individualize instruction in a wide range of courses. JWCC is also making plans to deliver college courses to rural communities via the computer, modems, and telephone lines.[15]

The instructional requirement for remediation is exemplified in community colleges' participation in Job Training Partnership Act (JTPA) programs, and there is extensive research reported in such activities. For example, a project was conducted at Pennsylvania State University to develop evaluation designs for CAI packages used in the remediation of basic skills in JTPA programs. The project developed a system of classifying CAI packages based on the needs of the

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[14] E. Balajthy. A Computer-Based Network for Writing Process Instruction of At-Risk Community College Students: A Second Year Evaluation. ERIC/RIE Reports 1989.

[15] J.T. Drea and L. P. Armistead. Serving Distant Learners through Instructional Technologies. ERIC/RIE Reports 1988.

JTPA population and the degree of complexity and quality of the technology employed in the CAI packages used by JTPA programs in the remediation of basic skills.[16]

In one study reported at Houston Community College twenty-seven participants in a Job Training Partnership Act-funded literacy program received one of three types of computer-assisted instruction (CAI). The project found that the longer CAI was used, the higher the posttest reading and mathematics scores. This project also reported that students with higher skill levels at entry learned faster with CAI systems.[17]

Another study by Houston Community College evaluated the use of the PLATO/CCC system with JTPA participants at the Texas Center for Adult Literacy and Learning. The following results were among those reported: (1) overall increases were shown in each skill area; (2) the CAI systems were most useful in supporting reading and math instruction, although upper-level students also benefitted from the language components of the CAI systems; (3) with lower-level students, the more effective CAI systems were those that

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[16] G.M. Charleston and others. A Project To Design an Evaluation of the Appropriateness and Effectiveness of Computer-Assisted Instructional Packages Used in the Remediation of Basic Skills. Pennsylvania State University, University Park. Institute for the Study of Adult Literacy. 1989.

[17] J. M. McCallister and others. "Evaluating Computer-Assisted Instruction in a JTPA Basic Skills Program." Adult Literacy and Basic Education; v12 n3 pp.151-62 1988.

were integrated with traditional teacher/student instruction, although upper-level students were equipped to work with CAI systems in self-directed modes; (4) student and staff attitudes were positive; (5) the PLATO/CCC configuration was clearly the most effective system for supporting math instruction and was also effective as a support for language instruction. Lowest-skilled groups of learners benefited less than more skilled students from CAI.[18]

B. Issues

Some of the broader issues arising from the use of computers in education are described by J. W. Leslie, who discusses education and computing in today's information-based society. Leslie identifies five areas in which issues generally arise: societal era, cultural background, educational setting, instructional methodology, and technology. Leslie points out that socio-cultural issues arising from the use of computers in education cannot be addressed in isolation and that strategies for integrating these areas should be developed.[19]

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[18] Don F. Seaman and J.M. McCallister. An Evaluation of Computer-Assisted Instructional Systems Used to Deliver Literacy Services for J.T.P.A. Participants at Houston Community College. Texas A and M Univ., College Station. Texas Center for Adult Literacy and Learning. 1988.

[19] J.W. Leslie. "Computing in a Multi-Cultural Environment." EDUCOM-Bulletin; v22 n4 p20-28 Win 1987.

Some issues are more closely related to the mechanics of learning, for example, students' textbook study skills. In a recent study at Indiana University computer programs were used to instruct students how to identify key concepts, compare and contrast concepts, and graphically map relationships among key concepts in textbook chapters. One hundred and eighty-four undergraduate students of matched ability from a major university and from a two-year community college were assigned to treatment and control groups to evaluate program effectiveness. Students who used the program significantly outperformed control group students, and learned strategies transferred to new textbook chapters.[20]

Remediation is one of the community colleges' most common instructional responsiblities, and, as we have seen, CAI is being used more and more in remedial programs. One of the issues arising from such programs is the extent to which students can achieve remediation through the use of computers. In a recent report G. L. Cox identified variables which predicted student performance in a community college remedial mathematics laboratory. Mathematics pretest scores, mathematics skills test scores, attendance time, age, gender, and attitude were used to help predict achievement. In a two-year study of 280 students gender, time of

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[20] Larry Mikulecky. Development of Interactive Computer Programs To Help Students Transfer Basic Skills to College Level Science and Behavioral Science Courses. Indiana Univ., Bloomington. 1988.

attendance (day or evening), and attitude were shown to be independent of achievement as measured by grades. Pretests, age, and the mathematics skill test were found to be significant in predicting students' final grades and accounted for 31 percent of the variance.[21] These results suggest a threshold of prior skills level below which students may not be successfully remediated through the use of CAI alone.

One of the most common problems that community colleges are encountering in the implementation of computer-based resources for instruction is that computers are being acquired before appropriate policies, plans, and procedures have been developed for their effective management.[22] D. Oettinger describes Ulster County County Community College's efforts to ensure that microcomputer resources were allocated so that the greatest number of students could have access to the greatest number of microcomputers for the longest periods of time. A systems approach was used to develop a conceptual overview of the college's academic computing facilities.[23]

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[21] G.L. Cox. Characteristics Related to Student Performance in a College Remedial Self-Paced Mathematics Laboratory. ERIC Reports. 1990.

[22] H.R. Gentry. Developing an Academic Information Resources Master Plan: A Paradigm. ERIC/RIE Reports 1987.

[23] D. Oettinger. "Using General Systems Theory to Allocate Microcomputer Resources." Community & Junior College Libraries; v6 n1 pp.95-102 1988.

IV. Computer Assisted Instruction at San Juan College

A. Progress and Practice

Here at San Juan College we have a history of isolated efforts to implement CAI. There are some facilities using state-of-the-art equipment without planned curriculum integration, but on the other hand there are some sadly overloaded, almost obsolete facilities which are used extensively in work required for core courses. Even the facilties which have up-to-date equipment and software which is well-integrated into coursework are overloaded. There has been progress, it is true, in adopting a planning approach to the use of CAI, but the fact remains that there are wide disparities between the computer resources available for student use, and these disparities seem to be related to the disciplines. In short, some subjects are well-supported by computer resources while other subjects are not so well supported.

B. Issues

The CAI-related issues facing San Juan College concern the inconsistent availability of computer resources among disciplines; the lack of comprehensive planning and support, and the consequent lack of standards for equipment, equipment maintenance, software, and faculty training. There is little or no institutional support, in terms of staff and facilities, for faculty efforts to implement CAI.

C. Faculty survey

As part of the research conducted for this report a faculty survey was conducted. Since faculty involvement is essential to the realization of the potential benefits of CAI, it is important to assess faculty views. Faculty surveys about computers in instruction are widely reported, for example, L.P. Armistead reports the results of a national telephone survey of community college faculty: faculty members in all disciplines agreed on the value of the use of microcomputers in the classroom.[24] In a 1988 survey of faculty attitudes toward their own use of computers at Oakland Community College 86% of the respondents indicated a high level of interest in using computers, though only 20% felt they had a high level of computer literacy; 64% believed computing was important to their discipline; but 53% felt their computer skills were inadequate for their discipline, and 43% expressed a need for help in using computers. Faculty were equally interested in the use of computers to increase their personal productivity and as an instructional delivery tool.[25]

1. Purpose

In the Spring term, 1991 a faculty survey at San Juan College assessed faculty attitudes and needs.[26] A copy of

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[24] L.P. Armistead, and others. "Impact of Microcomputers on Community College Faculty." Community College Review; v15 n2 pp.38-44 Fall 1987.

[25] H.S. Austin. Results of Faculty Computing Survey. ERIC/RIE 1988.

[26] The survey form is reproduced in Appendix (i).

the survey attitude questions appears below, in Figure 1. The survey assessed faculty attitudes toward CAI and identified some faculty needs related to CAI.

Attitude survey items were presented as positive statements about CAI and respondents were asked to indicate, on a scale from 1 to 5, whether they disagreed or agreed with the statements. The attitudes survey items 1, 9, 11, and 12 address the most important issues in Educational Technology identified in a 1988 state-wide survey of teachers in

ATTITUDES

Please indicate your agreement or disagreement with the following statements by circling a number on the scale from 5. for strongest agreement, down to 1 for strongest disagreement:

	AGREE				DISAGREE
1. CAI can help me be a more effective teacher	5	4	3	2	1
2. CAI can help students practice tasks	5	4	3	2	1
3. CAI can actually teach new concepts	5	4	3	2	1
4. CAI can test students' knowledge	5	4	3	2	1
5. CAI can enrich study materials	5	4	3	2	1
6. CAI is an expensive learning tool	5	4	3	2	1
7. Students want to use CAI	5	4	3	2	1
8. CAI is good for remedial instruction	5	4	3	2	1
9. Administrators should be trained in the management of CAI	5	4	3	2	1
10. I do not have the time to keep up with developments in CAI	5	4	3	2	1
11. I think that CAI could make me a more productive teacher	5	4	3	2	1
12. I would like to know more about the CAI being used at other Community Colleges	5	4	3	2	1
13. There are enough CAI facilities at San Juan College	5	4	3	2	1

Figure 1. Attitude Survey Items

Texas.[27] The responses to these items which were obtained in

[27] K. Brombaugh and B. Crossland. "What Should A Center for Educational Technology Provide?" Technological Horizons in Education Journal, v.19 n.9, April, 1991, p. 78.

the Texas study can be compared to the results obtained here at San Juan College.

Items 9 and 13 have direct bearing on the teaching environment at San Juan College as far as CAI is concerned. Items 2, 3, 4, 5, and 8 all relate to common modes of CAI[28] and help assess respondents' familiarity with CAI practice.

Item 7 assesses respondents' attitude towards student motivation with regard to CAI. Items 6 and 10 assess perceived barriers to the use of CAI.

In the needs survey section, a copy of which appears below, in Figure 2, question 1 elicited expressions of specific needs. Question 2 identifies needs for a catalog-like resource. Question 3 assesses the level of need for a CAI review center. Question 4 identifies needs for assistance with curriculum integration for classroom activities. Question 5 also identifies needs for assistance with curriculum integration, but for such things as out-of-class drill & practice, tutorials, enrichment, and so on. Question 6 helps assess the degree of institutional direction that might be accepted by faculty. Question 7 addresses the turf issue. Question 8 identifies respondents' disciplines for correlation with attitudes and levels of interest.

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[28] see, ie., J. Griffiths. "Computer-Assisted Instruction." Encyclopedia of Microcomputers. A. Kent and J.G. Williams, eds. New York: Marcel Dekker, Inc.; 1988. v.3. pp.22-59.

NEEDS Please write in your answers to the following questions:

1. If the computer facilities were available what kind of help do you think you might need in setting up CAI for your students to use?

2. Would you like to have a list of the CAI packages that are available in your subject?

3. If a special facility was set up to allow you to try out different CAI systems would you use it?

4. Would you like to know how CAI could be added in to the classroom material you use in your courses?

5. Would you like to know how CAI could be used outside class by students in your courses?

6. Do you think that the college should provide guidelines, policies, and procedures for developing and implementing CAI?

7. Do you think that departments or divisions should manage their own CAI facilities or should the college manage all CAI facilities?

8. What discipline(s) do you teach in?

Figure 2. Needs Questions

2. Results

There were 31 surveys returned out of a distribution of 175 forms sent to all full-time and part-time faculty, representing a return rate of almost 18%. The results were anaylzed by computing X^2 and t-statistics, the average score and the index of consistency for each attitude item, and by tabulating the results of the needs survey questions. The average score for each attitude item indicates the general level of agreement with the statement. The index of consistency is a measure of the extent to which responses cluster around the average score, and indicates the degree to which respondents chose similar responses to each item. These results were then ranked by item to provide a picture of the attitudes of responding faculty. The generally high level of agreement found with the attitude items no doubt

reflects some self-selection on the part of respondents. That is to say, responses are more likely to be received from those who have some opinion about CAI, rather than from those with no opinion. Nevertheless, the results are statistically significant.[29]

As Figure 3., below, shows, item 2: "CAI can help students practice tasks," received the highest average score, and, as Figure 4., below, shows, more respondents were in agreement on this item than any other. The levels of agreement and consistency for Item 5: "CAI can enrich study materials," are also high, and Item 4: "CAI can test student's knowledge," also shows a fairly high level of agreement and consistency. There was also fairly good agreement between the average score and the consistency of results for Item 8: "CAI is good for remedial instruction."

Although Item 1: "CAI can help me be a more effective teacher," had one of the higher average scores, the level of consistency for this item was very low, reflecting a wide range of attitudes. The responses to item 13: "There are enough CAI facilities at San Juan College," are also interesting since this item had the lowest average score and a low level of consistency. Perhaps this result reflects the disparity in CAI facilities among departments. With regard to items 1, 9, 11, and 12 comparison with the results from similar questions asked in the 1988 state-wide survey of

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[29] See Appendix (ii) for statistical analysis.

teachers in Texas reveals the following: item 1: "CAI can help me be a more effective teacher," had a high average score of 4.33, but a very low level of consistency, showing

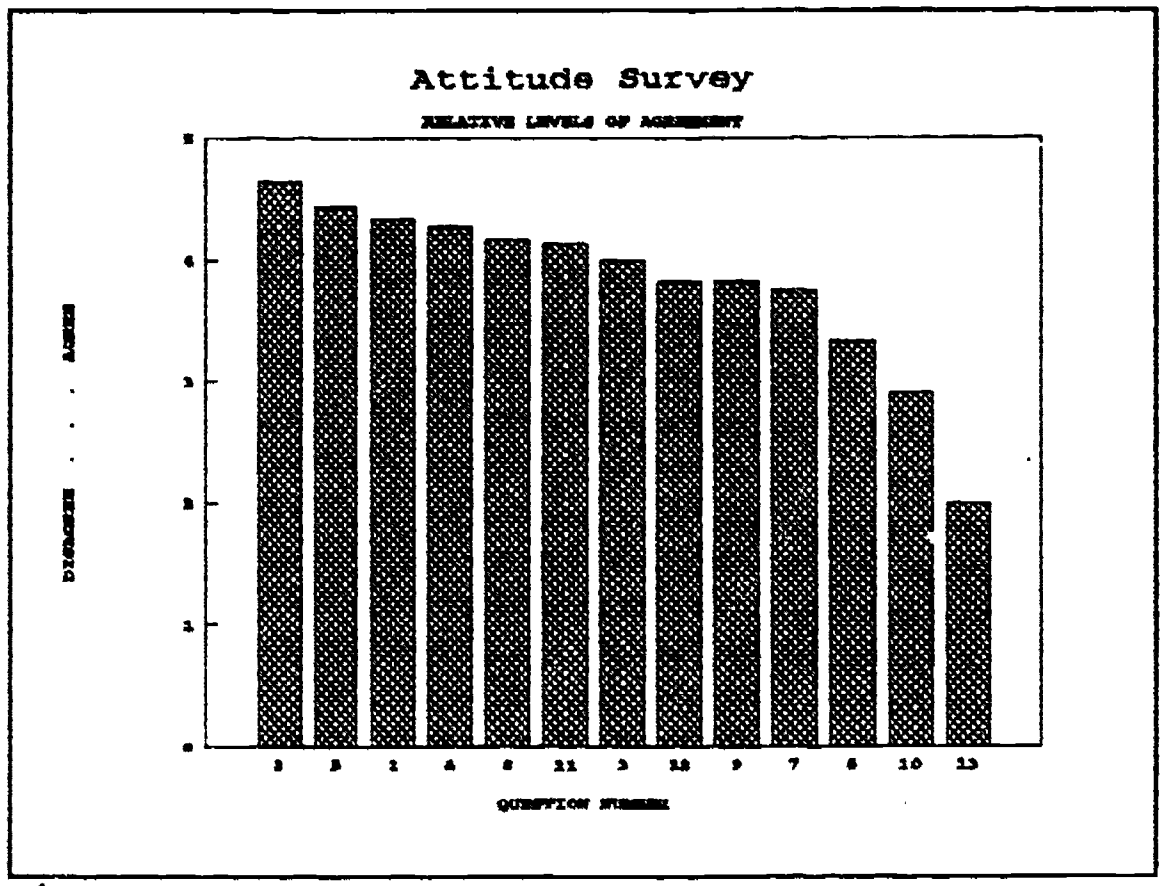

Figure 3. Rank by Average Score

that there is fairly strong disagreement with this statement on the part of a minority of faculty. Item 11: "I think that CAI could make me a more productive teacher," had an average score of 4.13, indicating agreement, but the responses were not consistent, indicating some disagreement on the part of respondents. The results of the Texas survey indicated that more research into the use of technology to improve teacher performance is most important to teachers. Faculty responses to item 9: "Administrators should be trained in the management of CAI" showed a fairly high level of agreement,

with an average score of 3.83, but with the lowest level of

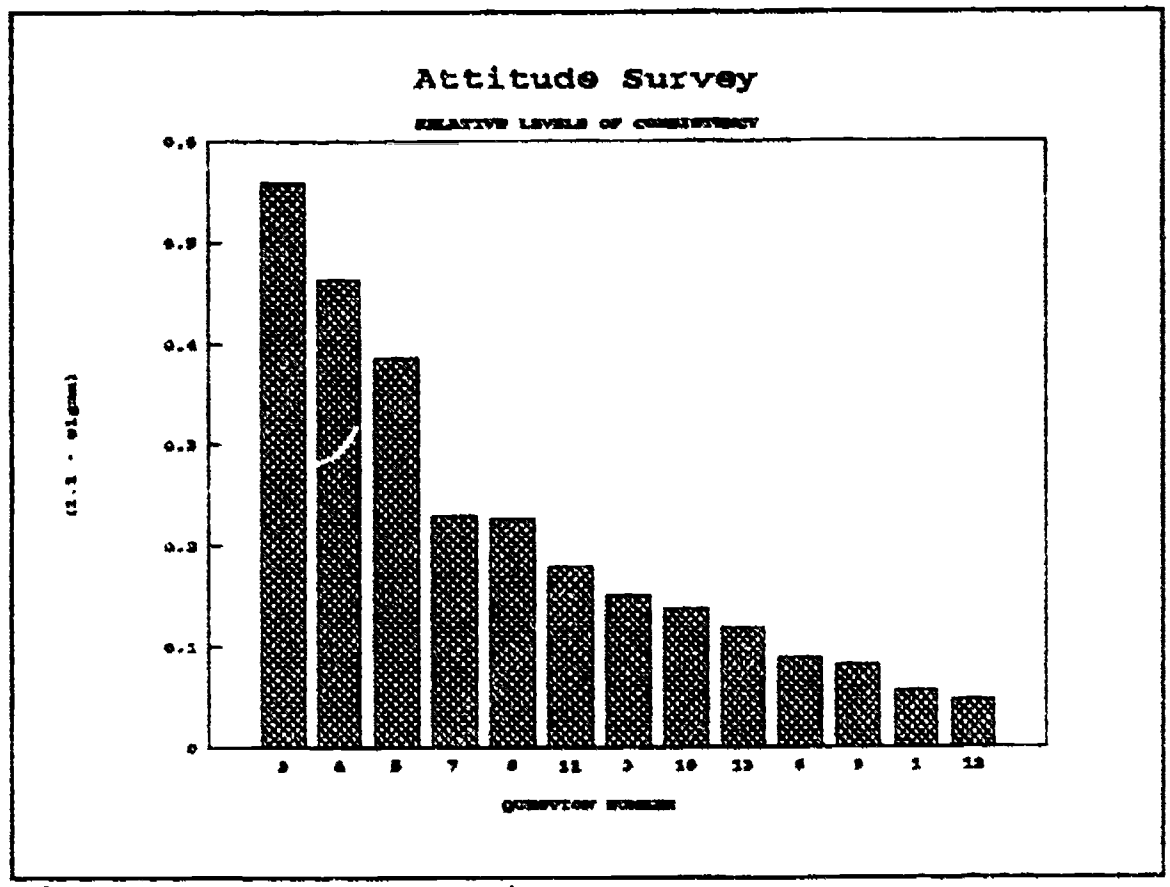

Figure 4. Rank by Consistency

consistency, indicating considerable disagreement, perhaps with the very notion that administrators should have anything to do with the management of CAI. The results from the Texas survey indicated that most teachers agreed that administrators should be trained in the management of CAI. Item 12: "I would like to know more about the CAI being used at other Community Colleges," had an average score of 3.83, indicating a moderate level of agreement, but with the lowest level of consistency, again, indicating considerable disagreement on the part of some faculty. In the Texas survey this item was ranked second only to research in

importance to faculty.[30]

With the exception of questions 1, 7, and 8, responses to the needs survey questions were mostly in the form of Yes/No answers, which are summarized below:

Question	YES	NO	OTHER
2 Would you like a list of CAI pa · ages in your subject?	28	2	
3 Would you use a CAI systems evaluation facility?	29	1	
4 Would you like to know how to add CAI to classroom work?	28	2	
5 Would you like to know how to use CAI outside the classroom?	29	1	
6 Should the college provide procedures for implementing CAI?	19	4	7

Responses to question 1 identified the kinds of help that faculty felt they might need in setting up CAI for their students to use; responses to question 7 revealed a wide range of opinions regarding the management of CAI facilities. Responses to the first seven needs questions were used as a basis for preparing the draft institutional policy and procedure objectives in the appendices to this report.

Responses to needs question 8: "What discipline(s) do you teach in?" showed that faculty from every division and from almost every discipline responded to the survey. Nine responses came from faculty in Mathematics and/or Computer

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[30] K. Brombaugh and B. Crossland. "What Should A Center for Educational Technology Provide?" Technological Horizons in Education Journal, v.19 n.9, April, 1991, pp. 78-80.

Sciences, six from technical/vocational studies, five from the English/Reading area, four from the natural sciences, three from the behavioral and social sciences, two from Business and Management, one from Nursing, and one response was identified as coming from "student leadership."

3. Findings

There are three general conclusions that can be drawn from the survey results. The most important faculty attitudes toward CAI can be summed up as a belief that CAI is most useful for practicing skills, for enriching study materials, and for testing knowledge. Since these are common **indirect** uses for CAI, it would seem that San Juan College faculty feel that CAI is best used **outside** the classroom. This conclusion is consistent with the survey results showing felt needs, on the part of faculty, for information about CAI packages in their subjects, for an evaluation facility, and for information about the uses of CAI for work outside the classroom. In addition, however, most respondents indicated a need for information about the uses of CAI **in the classroom**, indicating a willingness to explore in-class uses of CAI provided that it contributes to productivity and to teaching effectiveness. However, the evidence for strong disagreement, on the part of some faculty, with the statement that there are enough CAI facilities at the college leads to the conclusion that the use of CAI **outside**

the classroom should be more fully developed before in-class uses are explored.

V. Guidelines for further progress

A. Instruction

Progress in instruction can be made in two specific areas, first, the development of better understanding and skills, on the part of faculty, of the roles and uses of CAI; and second, the adoption of CAI packages and the in-house development, through authoring, of CAI resources.

As L.M. Kendra has recently pointed out "the greatest use of computers in courses other than computer and information sciences is still in drills, tutorials, writing composition, and simulations." Kendra also argues "that there is little research-based data on the effectiveness of computers as a method of instruction or on the time, energy, and resources required to prepare to use computers in instruction."[31] As I have shown there is in fact research reported on these topics, but the point concerning the use of computers in instruction is correct. As D.F. Salisbury states, "recent research on cognitive learning suggests that the role of drill and practice in learning may be more important than has previously been realized. The research suggesting this

[31] L.M. Kendra and J.B. Clavner. Coding Language vs. Authoring System: To Code or Author--That Is the Question. ERIC. 1990.

idea relates to the **automaticity of subskills."**[32]

The automaticity of subskills is an empirical, problem-solving notion, already familiar to most teachers, which can be expressed as the requirement that a student should possess a repertoire of subskills which have been practiced to the point of automatic, almost mechanical application in a problem-solving context. The conceptual basis for the idea of automatic subskills is that a skill can be decomposed into a hierarchy of subskills each of which is necessary for the successful demonstration of a skill. It is relevant to point out that testing a student's ability to demonstrate a skill provides grounds for assuming that the student has mastered the requisite subskills **provided that the students passes the test.** Where the student does not pass a test further diagnosis of subskill abilities is required for remediation. The automaticity of a subskill means that once a student has identified the need to perform a specific subskill no further analysis is required, the subskill is automatically performed correctly.

If CAI is to be used for drill and practice it is essential that the subskills mastered through practice outside the classroom are directly related to the requirements of classroom work, and that unrelated subskills are not

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[32] David F. Salisbury. "Cognitive Psychology and Its Implications for Designing Drill and Practice Programs for Computers." Journal of Computer Based Instruction; v17 n1 p23-30 Win 1990.

required in the practice sessions. This implies that teachers should either become familiar with the content of CAI packages for their subjects in terms of the specific skills exercised therein, or that they create their own drill and practice systems so that the classroom work and the outside drill and practice are as closely related as possible.

There are so many drill and practice packages available that it is quite difficult for any individual teacher to find the time to identify, acquire, and evaluate them all.

The in-house preparation of CAI resources involves the use of authoring facilities, such as SUPERPILOT or ICON AUTHOR, which are general-purpose systems for the creation of training and testing software. The training aspect involves the presentation of frames consisting of problems and questions; the testing aspect involves the evaluation of student input and branching to appropriate, subsequent frames. Note that both aspects are required in order to support effective, self-paced CAI.

It is not difficult for a teacher to learn how to use authoring facilties. It is difficult for a teacher to find the time to analyse subskills and to develop the definitions of frame sequences, all of which must be done before an authoring system can be employed.

B. Administration

The faculty's attitude notwithstanding it would probably be useful if administrators received some training in the implementation and management of CAI. Implementation of CAI, whether through purchase of packages or through in-house development, requires resource committments, and identifying the nature and amount of resources required is something that administrators should do rather than faculty.

VI. Conclusion

It is not surprising that faculty express generally positive attitudes toward CAI, although, as we have seen, there is some evidence for less positive attitudes. The faculty also express a need to know more about CAI. This need takes two forms - one, a need to know about specific resources, especially packages, and two, a need to know more about the ways that CAI can be used. An institutional facility for CAI training, evaluation, and resource development would serve the faculty's needs.

Students can benefit from specific forms of CAI, for example, for remediation, for skills drill and practice, and for testing. However, the research shows that students need to have attained a minimum level of skill, especially in mathematics, and probably in reading, before CAI can be expected to be effective.

APPENDICES

Appendix (i) Faculty Survey

Dear Colleague, this brief survey is part of a project, funded by a college mini-grant, to assist faculty who want to explore, evaluate, adopt, or develop computer-assisted instruction (CAI), which includes the use of computers, both in-class and out of class, for direct and indirect instruction. Your answers will help determine what types of assistance are made available. Thank you for your participation.

Please return completed survey form to: **J. Griffiths, COSC.**

ATTITUDES
Please indicate your agreement or disagreement with the following statements by circling a number on the scale from **5**, for strongest agreement, down to **1** for strongest **disagreement**:

	AGREE . . DISAGREE
1. CAI can help me be a more effective teacher	5 4 3 2 1
2. CAI can help students practice tasks	5 4 3 2 1
3. CAI can actually teach new concepts	5 4 3 2 1
4. CAI can test students' knowledge	5 4 3 2 1
5. CAI can enrich study materials	5 4 3 2 1
6. CAI is an expensive learning tool	5 4 3 2 1
7. Students want to use CAI	5 4 3 2 1
8. CAI is good for remedial instruction	5 4 3 2 1
9. Administrators should be trained in the management of CAI	5 4 3 2 1
10. I do not have the time to keep up with developments in CAI	5 4 3 2 1
11. I think that CAI could make me a more productive teacher	5 4 3 2 1
12. I would like to know more about the CAI being used at other Community Colleges	5 4 3 2 1
13. There are enough CAI facilities at San Juan College	5 4 3 2 1

(continued over)

NEEDS **Please write in your answers to the following questions:**

1. If the computer facilities were available what kind of help do you think you might need in setting up CAI for your students to use?

2. Would you like to have a list of the CAI packages that are available in your subject?

3. If a special facility was set up to allow you to try out different CAI systems would you use it?

4. Would you like to know how CAI could be added in to the classroom material you use in your courses?

5. Would you like to know how CAI could be used outside class by students in your courses?

6. Do you think that the college should provide guidelines, policies, and procedures for developing and implementing CAI?

7. Do you think that departments or divisions should manage their own CAI faclities or should the college manage all CAI facilities?

8. What discipline(s) do you teach in?

Appendix (ii) Faculty attitude survey data analysis

ATTITUDE ITEMS

F R E Q U E N C I E S

Item	AGREE 5	4	3	2	DISAGREE 1	COUNT	AVERAGE	STD. DEVIATION
1	17	10	1	0	2	30	4.33	1.04
2	21	9	1	0	0	31	4.65	0.54
3	11	12	5	3	0	31	4.00	0.95
4	11	15	3	0	0	29	4.28	0.64
5	16	12	1	1	0	30	4.43	0.72
6	6	4	14	6	0	30	3.33	1.01
7	5	13	9	0	1	28	3.75	0.87
8	13	9	6	1	0	29	4.17	0.87
9	10	6	12	0	1	29	3.83	1.02
10	1	8	11	9	2	31	2.90	0.96
11	11	15	2	1	1	30	4.13	0.92
12	7	15	4	1	2	29	3.83	1.05
13	0	2	8	7	12	29	2.00	0.98

Chi squared statistics

With 4 degrees of freedom (five possible responses to each item) the 95% criterion value for the Chi squared statistic is **9.487**. Chi squared values **higher** than the critical value indicate that the responses **are not** randomly distributed and represent the distribution of responses for the entire population at a statistically significant level.

Item	Chi squared
1	34.54838
2	53.35483
3	17.22580
4	30.25806
5	35.83870
6	16.80645
7	19.51612
8	19.29032
9	18.32258
10	12.70967
11	27.77419
12	20.58064
13	15.09677

t - Test Statistics

For the number of responses shown for each item (n), and assuming a standard value of 3 (the average of 1 and 5) for each item, t-statistic values larger than the critical value indicate that the sample average score for an item represents the average score for that item for the whole population at a statistically significant level.

Item	n	Sample Average	Standard Error	t Statistic	critical value	95% Significant
1	30	4.33	0.191	6.999	2.045	YES
2	31	4.65	0.097	16.909	2.042	YES
3	31	4.00	0.171	5.858	2.042	YES
4	29	4.28	0.118	10.774	2.048	YES
5	30	4.43	0.131	10.969	2.045	YES
6	30	3.33	0.185	1.806	1.699	YES (90%)
7	28	3.75	0.165	4.556	2.052	YES
8	29	4.17	0.162	7.226	2.048	YES
9	29	3.83	0.189	4.372	2.048	YES
10	31	2.90	0.173	0.560	2.042	NO
11	30	4.13	0.168	6.737	2.045	YES
12	29	3.83	0.195	4.234	2.048	YES
13	29	2.00	0.182	5.480	2.048	YES

Appendix (iii) Draft institutional policy objectives

Several respondents to the survey pointed out that institutional policies and procedures should be developed with the participation of faculty. Rather than draft policy and procedure, then, I have chosen instead to suggest **objectives** for policies and procedures. These objectives should be validated through faculty and administration discussions and then written policies and procedures can be developed.

1. Use CAI wherever and whenever instructional benefits can be shown provided that institutional cost-benefits can also be shown.

2. Establish a facility to support the demonstration, review, evaluation, installation, and maintenance of CAI systems. The facility to include staff, equipment, and software and a rotating collection of CAI software for demonstration, review and evaluation. This facility should also function as a training center for faculty and administrators.

3. Establish and maintain institutional standards for acquisition and maintenance of computer hardware and related equipment to support CAI.

4. Provide space for the installation of CAI facilities conforming to policy objectives 1. and 2.

5. Coordinate the management and operation of all instructional computing activites.

Appendix (iv) Draft institutional procedure objectives

The following suggested objectives identify issues which should be addressed by written procedures.

1. Review of CAI software
2. Acquisition of CAI software
3. Provision of CAI training
4. Acquisition of computer and related equipment
5. Operation and management of CAI facilities

Appendix (v) Selected Educational Systems Vendors

This is a (very) partial list of vendors who offer products which may be of interest to San Juan College faculty. As additional catalogs and announcements are received they will be added to this list. An updated list and catalog collection will be kept somewhere on campus, perhaps in the library, probably in John Griffiths' office.

Humanities and Sciences

Academic Computing Specialists
Salt Lake City UT
(801)483-3923

MINITAB Stats package

Addison-Wesley Publishing Co.
Jacob Way
Reading MA 08167
(617)944-3700
Tim Spade

English Language Training

American Language Academy
1401 Rockville Pike
Rockville MD
(800)346-3469

LOTUS 1-2-3 textbook and disk

Course Technology
One Main St.
Cambridge MA 02142
(800)643-7450
Peter Lester

Davidson and Associates
Torrance CA

Writing, Language Arts

Educational Activities, Inc.
Freeport NY
(800)645-3739

General, Networkable

Educational Resources
1550 Executive Drive
Elgin IL 60123
(800)624-2926
Paul (x261)

General

Focus Media
Garden City NY
(800)645-8989

Reading, remedial & basic

Hartley Courseware, Inc.
Diamondale MI

General

IBM Corporation
White Plains NY
(800)426-2468

Interactive Physics

Knowledge Revolution
497 Vermont St.
San Francisco CA 94107
(800)766-6615

Writing and Writer's Tools

MindPlay (via Educational Resources)
(800)221-7911
Joe Mason

Skill Assessment

Skill Bank Corp.
Ft. Meyers FLA
(800)222-3681
Kathy Wilson

Organic Chemistry

Snowbird Software
714 LeLand St.
Hamilton ONT L8S 3A1
(416)521-9667